

**"Ponderibus Libris suis,
Et processu est gravitate sui."**

* This trainee may perhaps shock those who put faith in the theory which demands the form of the roadway of a bridge from the intrusion of the arch. This system is a misapplication of the theory of the equilibrium of chains; in venture attempts to have reasoned in this way: in order to make a chain assume a particular form, it must be loaded in a particular manner; therefore an arch of the same form should be loaded in the same manner. To make a chain assume the form of a semi-circle, it would have to be loaded towards the points of suspension, of *infinites*, therefore the roadway of a suspension bridge should be semi-circular arch should be lighted in the same way. The theory fails to show how this is to be performed, or how a material of finite strength is to bear an infinite burden. Again, a chain loaded in the middle may be made to assume the form of a pointed arch, therefore a pointed arch should be loaded in the middle. Some persons, apparently convinced by such reasoning, have supposed that a pointed arch should be loaded over the crown to prevent it from springing upwards. This is the theory, that which demands the form of the roadway from the form of the roadway, is not liable to the same criticisms.

The least pressure upon the voussoirs of an arch is at the vertex, and is called the horizontal stress, or thrust; any other part of them is subject not only to this, but also to a vertical one, depending upon the weight above it, so that the greatest pressure is at the abutments. It would not be well, therefore, to make the thickness of an arch less towards the abutments than at the crown; nor would it be quite proper to make it every where the same, though the materials used sometimes exact this. Since in arches of cemented masonry the greatest compression is at the joints, it appears proper that the voussoirs should be increased in thickness in the same proportion as the pressure upon them increases, namely, as the resultants of the horizontal and vertical pressures. The vertical cohesion of the materials, however, greatly influences the strength of an arch. An arch built with concentric courses of brickwork would not be so strong as one built with well bonded work, from the same cause that two

The figure represents a bridge with a semi-circular arch and level roadway; the spandrels are supposed to be solid, and the greatest probable extraneous load which the bridge will ever have to sustain, is assumed to be equal to a mass of the materials uniformly spread over the whole of the roadway in depth equal to dc . It has been actually observed (it is not theory), that when motion takes place in an arch of the kind, there are two points (a and s , called points of fracture) in the intrados, the masses above which ($abcd$) tend to overturn the masses below them as well as the walls or the piers upon which they